Chapter 6. Sacramento River Hydrologic Region

Setting

The Sacramento River hydrologic region includes the entire drainage area of the State's largest river and its tributaries, extending from the Oregon border downstream to the Sacramento – San Joaquin Delta. The region covers 27,246 square miles including all or a portion of twenty predominately rural northern California counties, and extends from the crest of the Sierra Nevada in the east to the summit of the Coast Range in the west. The northernmost area, mainly high desert plateau, is characterized by cold, snowy winters with only moderate rainfall, and hot, dry summers. The mountainous parts in the north and east typically have cold, wet winters with large amounts of snow providing runoff for summer water supplies. The Sacramento valley floor has mild winters with less precipitation and hot dry summers. Overall annual precipitation within the region generally increases as you move from south to north and west to east. The heavy snow and rain that falls within this region contributes to the overall water supply for the entire state.

The many rivers and streams that are tributary to the Sacramento River provide important riparian habitat that is critical for many aquatic and terrestrial species including the Spring-run Chinook salmon (Oncorhynchus tshawytscha), Winter-run Chinook salmon (Oncorhynchus tshawytscha) and Central Valley steelhead (oncorhynchus mykiss). This region is the only known area for the Winter-run Chinook. The valley floor region section adjoining the river, provide some of the most important wintering areas along the Pacific Flyway for many varieties of waterfowl. The region also houses several wetland and waterfowl preserves that provide nesting and migration areas for threatened avian species including the bald eagle and Swainson's hawk and numerous species of neotropical birds. All of these valuable resources are vital components of the ecosystem and contribute to the ecological health of the entire state.

Agriculture is the region's largest industry, contributing a wide variety of crops including rice, grain, tomatoes, field crops, fruits and nuts. Crop statistics show that irrigated agricultural acreage in the region peaked during the 1980s and has since declined with a little over 2 million acres irrigated in year 2000. Excess applied irrigation water generally returns to the supply system through drainage canals, or recharges groundwater. Basin efficiency is usually very good because downstream users recycle return flows for their own use. In some places, return flows are the only water source for downstream agricultural users.

Most urban development has been along the main highway corridors. A few of the larger cities in the region take the majority share of their water supplies from the larger rivers, but throughout most of the region, groundwater is the principal source of water for urban and rural dwellers. The Sacramento Valley is recognized as one of the foremost groundwater basins in the state. In the rural mountain areas of the region, domestic supplies come almost entirely from groundwater.

The Sacramento River Hydrologic Region also encompasses all or a portion of six of the state's eighteen national forests. Lassen, Mendocino, Modoc, Plumas, Shasta-Trinity and Tahoe Basin National Forests are contained or contiguous to the region and contribute to the dynamics of its vast landscape. These federally-owned lands are each managed with specific goals for fish and wildlife such as the recovery of the spotted owl or the Chinook salmon, as well as for hydro-power and sustainable timber harvest. Such

diverse goals often call for creative management strategies. Total acreage for Nation Forest properties within the region is _____.

Population

The population of the Sacramento River hydrologic region was approximately 2,593,000 in year 2000, which represents about 14 percent of California's total population. Referencing the Table Sacramento River Region Population Density By County, geographically, the largest county within the region is Siskiyou (6,287 square miles), with a current population of 44,650 or about 7 persons per square mile. Sacramento County is the most populated county within the region, with a density of 1,273 persons per square mile. When looking at the map of the region on page 3 of this report, it should be noted that both of these counties are only partially within the region. However, these statistics are useful in portraying the environment of the region, which (except for Sacramento) is predominately rural in nature with low population ratios per square mile.

Although population numbers are less dense than other regions of the state with the current total population for this vast geographic area are a little over 2.5 million persons, it is anticipated that population numbers will increase to over 4.3 million by the year 2030. This growth will have a significant impact on shaping the natural resources of the region. Population per square mile decreases as you move further north into the region, which contains immense areas of agriculture and timberlands, both private and public owned.

Future land use planning and decisions, at both the state and local level, will need to consider the changing complexion of the region, as well how to best utilize and preserve the vast open spaces and abundant natural resources still available within the region.

Sacramento River Region Population Density By County

COUNTY	POPULATION	SQUARE MILES	PERSONS PER SQUARE MILE
Butte	206,800	1639	126
Colusa	19,300	1151	17
El Dorado	163,900	1711	96
Glenn	26,850	1315	20
*Lake	60,200	1258	48
*Lassen	34,350	4557	8
*Modoc	9,450	3944	2
*Napa	128,100	754	170
Nevada	94,200	958	98
Placer	261,500	1404	186
Plumas	21,000	2554	8
Sacramento	1,267,800	996	1,273
Shasta	168,600	3785	45
*Sierra	3,550	953	4
*Siskiyou	44,650	6287	7
Sutter	81,000	603	134
Tehama	56,500	2951	19
*Trinity	13,050	3179	4
Yolo	174,500	1013	172
Yuba	61,300	631	97
* represents counties only partially covered within the region			

California Dept. of Finance (July, 2001 Estimated)

Water Supply and Usage

Because of the weather patterns that produce a high level of precipitation within the region, major water supplies from within the region are provided through the development of surface storage reservoirs and from direct groundwater pumping, which historically has recharged through the winter months. Major reservoirs in the region provide water supply, recreation, power, environmental, and flood control benefits. The Central Valley Project (CVP) is the largest water project in the state, and includes Shasta Lake, Whiskeytown Lake, Keswick Reservoir and Folsom Reservoir within this region. A large portion of the water supplied by CVP facilities is delivered for agriculture purposes, both within this region and as water exports to other regions. USBR's Solano Project provides urban and agricultural water supply to parts of the Sacramento River Region and parts of the San Francisco Bay Region. The major water supply facilities of the State Water Project (SWP) are located along the Feather River basin within this region, consisting of Oroville Reservoir, Thermalito Afterbay, Lake Davis and Frenchman Reservoir. SWP water supplies serve both urban and agricultural uses in this region and are exported southward to other drier regions of the State. A large amount of stored water from both CVP and SWP reservoirs is released downstream to maintain environmental water quality standards in the Sacramento – San Joaquin Delta. Such storage releases are critical in the summer and fall months, to prevent ocean salt water from penetrating eastward into the Delta during high tidal cycles.

There are several other, smaller reservoirs that add to the overall surface water supply. In total, the region has 43 reservoirs, with a combined capacity of almost 16 million acre feet (maf). Major reservoirs within the region provide not only water supply, but also are the source of recreational opportunities, power generation, and other environmental and flood control benefits. In addition, the region has a network of creeks and rivers that convey water for use throughout the region and also provide nesting and rearing grounds for major fish and wildlife species of concern.

Water usage in the Sacramento River Region is predominantly for agricultural production with over 2.1 million irrigated acres recorded in 2000. Agricultural products include a variety of crops such as rice and other grains, tomatoes, field crops, fruits and nuts. There is also a substantial number of acres held in rangeland for livestock management. (Need % and rangeland numbers here) Much of the economy of the region relies on agricultural water supplies, which are diverted and distributed through extensive systems of diversion canals and drains. Basinwide water use efficiency is generally high, because many return flows from fields are captured by drainage systems and then re-supplied to other fields downstream. In some places, these return flows are the primary water source for other downstream agricultural users. In addition, excess applied irrigation water can return to the supply system by percolating downwards as groundwater recharge.

The larger urban areas in the region have historically developed near the major rivers, such that surface water diversions are a key component of municipal water supplies. However, the Sacramento Valley is also recognized as having one of the foremost groundwater basins in the state. The availability of abundant groundwater supplies under the valley floor regions has allowed urban areas to expand delivery capabilities by including the use of groundwater. In some areas, groundwater has become the principle source of water supply for urban as well as rural domestic uses.

In-stream flows, refuges and wildlife areas are the principal environmental use of water within the region. With the federal and state listing of the Spring-run Chinook salmon, Winter-run Chinook and Central Valley steelhead, much attention has been given to the recovery of these species and their related habitat.

Tributaries to the Sacramento River, as well as the main stem itself, have been the focus of a number of ecosystem-related projects designed to increase the amount of environmental water use for habitat and species restoration.

In addition, the Sacramento Valley serves as a breeding and resting ground along the Pacific Flyway. Therefore, in more recent years, duck and other waterfowl habitat development in the valley section by duck clubs, non-profit groups and natural resource agencies have resulted in an increase in the use of environmental water in an attempt to increase the numbers of waterfowl species residing within or using the region. Certain agricultural practices are known to benefit many species of wildlife. The programs that provide the most benefits are the rice straw decomposition program and the use of agricultural return flow to refuges and duck clubs, which are designed to improve air and water quality in the valley. As a result of these programs, and other resource management activities, the Sacramento River Region contains the largest and most extensive wetlands in the state. The Sacramento River Region has a number of acres in both private and public ownership dedicated to managed wetlands. For example, in the northeastern mountain counties, associated with the Pit River system, (such as the Big Valley and Alturas area), there are approximately 14,000 acres of managed wetlands. Further south, moving into the Sacramento Valley section, there are 16,987 acres in federal ownership; 11,987 acres of state lands; and 28,642 acres in private ownership currently managed as wetlands.

With the listing of the Winter-run Chinook, Spring-run Chinook salmon and Central Valley steelhead, much of the water diverted out of the Sacramento River waterways for agricultural use, environmental uses and refuge water supplies passes through state-of-the-art fish screens. These fish screens minimize take of the species when water is diverted from the river, and also increases system flexibility, allowing year-long diversion of water for agricultural purposes.

Current Situation

Table 6-1 presents a Water Supply Balance for this hydrologic region for years 1998 (wet), 2000 (average rainfall) and year 2001 (a dry year). The total sources of all water supplies to the region are tabulated in the top portion of Table 6-1, the major uses of all water are shown in the middle section, and estimated interaction with groundwater storage is shown at the bottom of the table. Using year 2000 as an example, a significant portion of the precipitation (57,106 TAF) is used by native vegetation (forests), evaporation, unregulated runoff and percolation to groundwater (tabulated as 30,535 TAF). Statutory Required outflows to maintain Delta water quality requirements (SWRCB Decision 1630) are the next largest component of water use (11,415 TAF), followed by water exports to other regions (6,240 TAF) and the consumptive use of applied water within the Sacramento River region (5,538 TAF).
Table 6-3 provides more specific information about the developed or dedicated component of water supplies for agricultural, urban and environmental purposes, as assembled from actual data for years 1998, 2000 and 2001. This table provides more specific information regarding the distribution of developed water, including a high amount of agricultural usage. Note that the Environmental water use component of this Table includes the amount required to maintain Delta outflow standards, which amounts to more that half of the tabulated environmental water usage.

State of the Region

The 30 percent of the region's lands that are irrigated with groundwater generally enjoy a reliable supply as do those urban areas that depend on groundwater as all or part of their supply. However, groundwater development in fractured rock sources are highly variable in terms of water quantity and water quality and

are are an uncertain source for large-scale residential development. Groundwater quality in the Sacramento River Region is generally good, but there are areas with local groundwater problems. Natural water quality impairments occur at the north end of the Sacramento Valley where wells typically have high TDS content. Other local natural impairments are moderate levels of hydrogen sulfide in groundwater in the volcanic and geothermal areas in the western portion of the region.

In the more rural portions of this region, small, widely dispersed populations translate into high per capita costs for municipal water system maintenance and improvements. Historic development pattern of small geographically dispersed population centers can constrain the ability to interconnect individual water systems or to develop centralized sources of good quality municipal water supplies because major capital improvement projects become more expensive.

Exports from the Sacramento Valley are a concern for some water interest groups within the region, many of which are fearful of losing this resource considered a key component to future economic growth. Although is seems that there is an abundance of supply in this hydrologic region, infrastructure within the foothill communities is limited and water development has historically been constructed to meet the needs of the downstream urban and agricultural users, resulting in some outlying and foothill areas being subject to supply shortages in many years. The unique water problems of the foothill regions are described in more detail in Chapter 12 on the Mountain Counties regions. Urban areas in the central part of this region generally have sufficient supplies to survive dry periods with periodic cutbacks. However, as future population growth increases within the region, the competition for high quality water municipal water supplies will also increase.

Many north valley water users are also concerned that in the future their surface water rights may become further curtailed and more groundwater will be needed for irrigation as well as for urban use. In this light, they are apprehensive about new proposals involving the export of surface and groundwater supplies to other locations, unless proper planning is completed to provide assurances for retaining the supplies necessary to meet future agricultural, urban and environmental needs at the local level.

It is anticipated that such changes in surface water allocation within the region will probably occur with negotiations for renewal of CVP contracts, increased environmental restoration, expanded conjunctive use of surface and ground water, and various proposals and designs for water transfers. Cumulatively, these changes could stimulate a substantial increase in groundwater use within the region. In addition groundwater development will most likely be targeted to meet a significant share of the moderately increasing water demands of the region. In response to this phenomenon, some local governments within the region are investigating imposing strict groundwater regulations for new development to assure adequate supply for future needs.

The potential for developing new supplies from groundwater is most favorable in the northern portion of the Sacramento Valley. The southern portion is already experiencing localized groundwater supply and quality problems, such as in the Sacramento area. Although substantial groundwater can potentially be identified in the Sacramento Valley, there is still a great deal of research that needs to be completed to evaluate the quantity and quality of these supplies. In the event that additional groundwater supplies are identified and confirmed through scientific methods, much of the existing groundwater infrastructure would have to be replaced or modified to utilize the resource to its fullest prospective. Moreover,

additional groundwater utilization in the Sacramento Valley has the potential to decrease accretions or deplete river and tributary flow, which may have negative environmental impacts.

Competition for use of the groundwater resource is expected to continue as population increases occur, and the potential also exists for an increased number of water transfer programs in the future. Water transfers, especially those contracts with a groundwater substitution component, need to be evaluated for their cumulative effects, because the overall effect could contribute to greater usage of the groundwater resources within the region that may negatively impact local water users.

In recent years, requirements for managing threatened and endangered species are influencing management of the region's water supplies. The salmon and steelhead fishery in the upper Sacramento River has declined greatly over past decades, resulting in many programs and projects for fishery restoration. Along the Sacramento River, factors that contribute to this problem include: unsuitably warm water temperatures, toxic heavy metals from acid mine drainage, pesticides and fertilizer runoff, degraded spawning gravels, obstructions to fish migration, and prior loss of riparian habitat due to growth or noxious weed encroachment. It should be noted, however, that some riparian habitats are now being restored due to projects funded by the agencies associated with CBDA, which will be discussed later in this chapter.

In summary, the majority of the region does enjoy abundant groundwater and surface water supplies for all beneficial uses within the region. However, precautions should be taken with land use changes that may utilize a greater amount of the natural resources because the majority of the area is just beginning to understand its groundwater resources and how they, combined with surface water supplies, can be used in the most efficient manner.

Challenges

Water Reallocation and Transfers

During extended periods of drought, water districts within the Sacramento River Region that are reliant on surface water supplies may be faced with insufficient water supplies, due to surface water allocation cutbacks imposed by their CVP and SWP water contracts. Although SWP supplies and CVP supplies may differ in their water cutback procedures, both may impose reductions to deliveries in an extended drought. Such reductions could eventually force water users to choose between using groundwater to replace the reduced surface supplies, or taking valuable agricultural acreage out of production. The additional use of groundwater supplies by a greater number of water users during drought periods may result in adverse impacts to the groundwater resource, which has the potential to negatively impact users that are totally dependent on groundwater supplies.

With a growing demand for high quality water throughout the state, water transfers are being evaluated more closely as a means to move water out of the Sacramento River Region to other parts of the state. In response, several counties within the region have passed ordinances that regulate or impede water transfers that transfer water outside of their county, primarily if the program has a groundwater component. In some counties, for instance transferees are required to mitigate for third-party impacts associated with this type of water transfer and transfers require a permit approved by the Board of Supervisors or their designee. In other counties, transferring groundwater outside of the county is currently prohibited.

Water Quality

With regard to drinking water quality, the Sacramento River Region currently enjoys predominately high quality water supplies. Therefore, the primary interest within the region is in maintaining the current high quality supply through monitoring and assessment intended to make high quality supplies available locally. Pesticide management and agricultural water discharge has recently come into the limelight with the Central Valley Regional Water Quality Control Board's decision to eliminate waivers associated with agricultural discharge. Groups within the region are forming partnerships to address this issue through a watershed approach as adopted by the Regional Board and affirmed by the State Water Resources Control Board. Stakeholders within the region are working to find a solution that encompasses the protection of public health, meets current and future water quality regulations, and allows for a sustainable agricultural economy.

Accomplishments

The goals and objectives of the CBDA program play a prominent role in regional efforts to improve water supply reliability, water quality and ecosystem restoration. Current activities and accomplishments are summarized in the following sections.

Water Supply Reliability

Past concerns with potential groundwater exports have spurred numerous counties to enact groundwater ordinances to regulate groundwater extraction when groundwater is intended for export outside the county. In addition, some counties are also involved in extensive cataloging and inventory projects to determine the extent of their water resources and unmet needs of the region to ensure that current and future needs are met locally prior to water exports.

In addition, regional representatives are working in conjunction with CBDA to conduct an extensive reevaluation of additional off-stream surface storage reservoirs within this region designed to store excess water during high flow events and thereby, help alleviate pressure for water exports from the region. Water use efficiencies within the region could provide benefits to other regions of the state if the storage and conveyance capacity existed to hold and transport water when it is needed. This process, commonly known as the North of Delta Off-Stream Storage (NODOS) is evaluating previously identified sites for their suitability in this type of project. Specifically, the Department of Water Resources is currently conducting an environmental evaluation of the Antelope Valley on the West side of the Sacramento River, near Maxwell for the construction of the off-stream of storage facility known as Sites Reservoir.

Water Use Efficiency

Water use efficiency in the Sacramento Valley is included in a comprehensive and integrated program being pursued by the diverters in the region. Most water losses within the region are "recoverable" which means that they return to rivers and streams where they can be re-used by downstream diverters. Because of this, there is limited local incentive to improve water use efficiency other than decreasing costs. CBDA's Water Use Efficiency program uses grant funding to provide incentives to water users in the Sacramento Valley to develop system improvements that will make water available for uses that provide statewide benefits. These benefits include improving endangered species habitat and improving overall water quality throughout the system by improving source water quality.

Agencies involved in CALFED's Water Use Efficiency Program, including DWR, have provided the following through Year 3 of the California Bay Delta Program:

- Partnerships forged for groundwater planning with local agencies in six areas.
- Work initiated on 22 groundwater management and groundwater storage projects.
- Progress made on studies for potential north-of-Delta off-stream storage and Shasta Dam enlargement. The proposed projects are among five surface storage options being studied to increase storage capacity and provide flexibility to the state's water system.
- $11 million in grants awarded for agricultural and urban water use efficiency programs.
- Key achievements made on streamlining water transfers and facilitating transfer agreements that protect local water users, economies and ecosystems.

Drinking Water Quality

Both groundwater and surface water supplies within the Sacramento River Region are of high quality, but there are some emerging areas with local groundwater problems. Natural water quality impairments occur at the north end of the Sacramento Valley where wells typically have high Total Dissolved Solids (TDS) content. Other local natural impairments are moderate levels of hydrogen sulfide in groundwater in the volcanic and geothermal areas in the western portion of the region. In the Sierra foothills there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Human-induced impairments are generally associated with individual septic system development in shallow unconfined portions of aquifers or in fractured hard rock areas where insufficient soil depths are available to properly leach effluent before it reaches the local groundwater supply.

The CBDA Water Quality Program has completed the following activities within the Sacramento River region:

- $595,000 invested in local project to protect drinking water quality and watershed health on Steelhead Creek in Sacramento County.
- Sanitary surveys completed for State Water Project and its key sources, including the Sacramento River watershed, which identified potential threats to water quality.
- Pilot study underway on options to reduce dissolved organic carbon and nitrogen exports from rice fields.
- Research funded through Ecosystem Restoration Program to investigate mercury and other pollutants from abandoned mines and/or the impacts of dredge mining.

Ecosystem Restoration

Prior to the Gold Rush of the late 1840s, the area known as the Sacramento Valley consisted of a warm and abundant natural environment, essentially a floodplain to the expansive Sacramento River, rich in natural habitats, such as oaks, sycamore and cottonwood. As the Gold Rush subsided, those it brought to California moved into the plains of the Sacramento Valley and began ranching and farming, clearing the land for these purposes. As the population bases increased in the valley, flood control projects and levees were created in an attempt to control the great river to the detriment of the natural processes of the river and the species that inhabited it. The CBDA Ecosystem Restoration Program attempts to return some of these natural functions to the creeks and rivers within the region to aid in the restoration and maintenance of the endangered species that once inhabited it.

Many ecosystem restoration programs and projects are underway in the Sacramento River Region. Some of these projects are along the main stem of the Sacramento River and others involve work along or in the tributaries. CBDA Ecosystem Restoration and Watershed Program efforts in the Sacramento River Region have focused on protecting and restoring habitat for threatened and endangered species, such as

salmonids and other fish species and wildlife. Ecosystem protection and restoration efforts on tributaries to the Sacramento River, as well as the main stem will help to provide habitat for these species while also maintaining water quality in the source area streams that eventually flow into the Bay-Delta.

The Sacramento Valley with its alluvial soils, abundant water and moderate climate, is one of the richest agricultural regions on earth. These same physical attributes also make it an incredibly productive ecosystem that supports over 250 species of fish and wildlife. For example, spring-run Chinook salmon swim in from the Pacific and climb 5,000 vertical feet, first through the Sacramento River and then Mill Creek, to spawn at the base of Lassen Peak. Canadian geese fly from north of the Artic Circle to winter in the wetlands, and Swainson hawks migrate from as far south as Argentina to reach the biologically-rich Sacramento Valley.

During the past 130 years, over 95 percent of the valley's historic riparian forests have been converted to other land uses. In 1988 federal and state agencies, along with interested stakeholders and regional and local nonprofit groups, began to stabilize this trend by protecting and restoring riparian habitat along the Sacramento River. To date, over 20,000 acres have been protected in such areas as the Sacramento River National Wildlife Refuge, the Bureau of Land Management's lands north of Red Bluff, Sacramento River State Wildlife Area, other State Parks within the region and various areas under private conservation ownership. In addition, approximately 4,000 acres of flood-prone agricultural land has been restored into riparian forest.

In 1986, the Legislature enacted Senate bill 1086, which called for development of a riparian habitat inventory and created the Upper Sacramento River Fisheries and Riparian Habitat Management Plan. The purpose of this plan is to preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the Sacramento River. The final plan contained a conceptual Riparian Habitat Restoration Plan to guide riparian habitat restoration along the river and its major tributaries from Red Bluff to Verona. An advisory board with representation appointed by the appropriate local governments was established. This body evolved into the Sacramento River Conservation Area Forum (SRCAF) in 1999. Each of the seven counties bordering the river within this region has a public interest, and a landowner member also serves on this board. The Board meets monthly to help guide activities that take place along the river.

The Management Plan for this program also contained a more specific Fishery Restoration Plan, listing 20 actions to help restore the salmon and steelhead fisheries of the river and its tributaries. All of the proposed restoration actions are now under way, funded by a combination of federal, State, and local sources. The Central Valley Project Improvement Act of 1992 (CVPIA) includes many of the CVP related fishery restoration measures recommended by the SB 1086 plan. (Need more info on CVPIA).

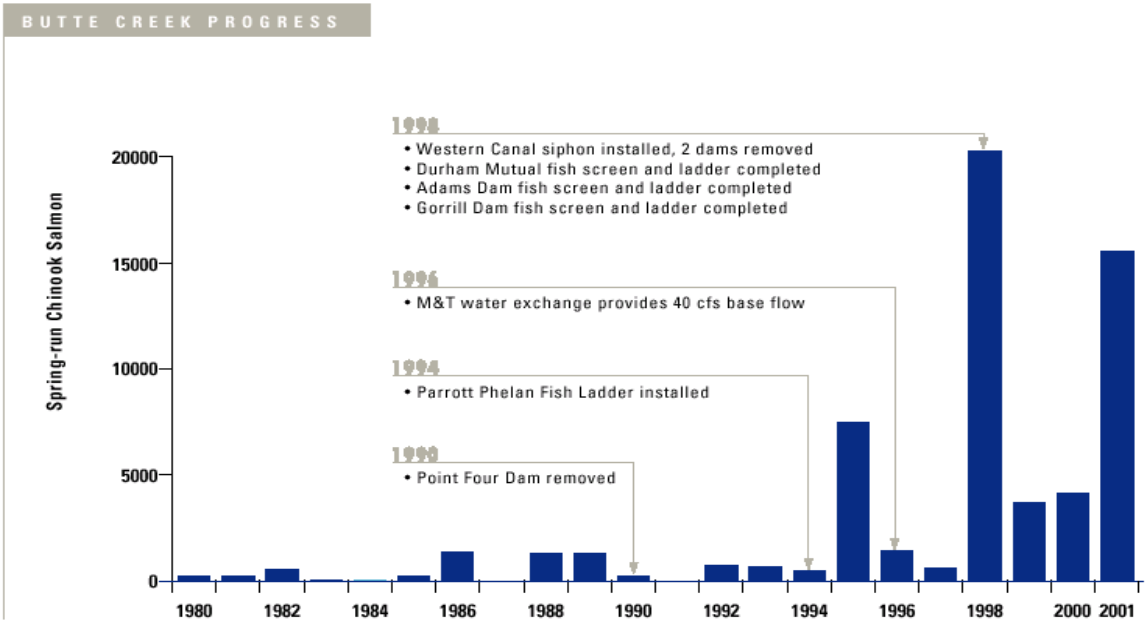
One of the concerns expressed by regional stakeholders involves land acquisitions for restoration projects that may not allow for reimbursement of tax dollars to local governments for land conversion projects. Local governments fear that the loss of revenue from productive agricultural land taken off of the tax roles may impact their ability to provide health and safety programs within their jurisdictions. In response to this concern, since 2000, the CBDA has begun utilizing conservation easements rather than direct purchases. This approach leaves the property on the tax roles, thus minimizing the negative impacts associated with land conversion.

Local governments would also like to see programs that provide for species recovery and protection which support reasonable recreational access for the public that would contribute to an increase in tourism dollars within the local economy. It is anticipated that increased recreation associated with a healthier river system will contribute to the local economy in the future.

Participants in the SRCAF are hopeful that the discussions that take place at the SRCAF, as well as its associated sub-committees, will address some of the concerns expressed above. One of the guiding principles of the program is to give full consideration to landowner, public and local government concerns. It is felt that to ensure that true system-wide planning is effective, the planning process must include participation by local government, environmental groups and agencies along the river. The SRCAF provides the opportunity and encourages this type of participation.

The Sacramento Valley Region is the focus of significant CBDA ecosystem restoration activities and many more are planned for the next several decades including species recovery programs of fish species. The CALFED Multi-species Conservation Strategy (MSCS) is a comprehensive regulatory plan for the CALFED Program developed in accordance with the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), and the Natural Communities Conservation Planning Act (NCCPA). The MSCS establishes the programmatic state and federal regulatory requirements for numerous species and habitat types throughout the focus area. By adhering to this plan, the program can be implemented in compliance with these regulating acts.

Increased concern over the decline in endangered salmon populations has stimulated several projects and programs within the region over the past several years designed to alleviate pressures on these fish species of concern. Significant work has been accomplished toward this end on Butte Creek, for example. Partnerships with several landowners and agricultural water districts along the creek have resulted in the removal, reengineering, and screening of several dams and the construction of a canal siphon beneath Butte Creek to aid in fish passage for spawning and rearing. These partnerships resulted in the removal of the Western Canal, McPherrin, McGowan, and Point Four Dams and screening modification or construction on five other diversions along this tributary. These efforts, that have been coordinated and partially funded through CBDA, have built strong partnerships within the valley between agencies and landowners. They have also realized an increase in the returning runs of Spring-run Chinook salmon up to their highest level in several years. These numbers are displayed in the following chart through 2001. Data collected from the 2002 and 2003 carcass counts indicate a continued high level of returning spawning populations.



Another major salmon recovery project within the Sacramento River Region is on Battle Creek. The Battle Creek Restoration Program proposes to restore access for salmon and steelhead to approximately 42 miles of habitat in the north and south forks of Battle Creek while minimizing the loss of clean and renewable energy provided by PG&E's Battle Creek Hydroelectric Project. The project includes removal of 5 diversion dams, construction of ladders and fish screens at 3 additional diversions and increasing flow releases from remaining diversion dams. Environmental documents for the project are being finalized and a proposal for additional funds is currently under review by the Ecosystem Restoration Program. The majority landowner within the project area, PG&E, is working with the Bureau of Reclamation, USFWS, NOAA Fisheries, Department of Fish & Game under a Memorandum of Understanding signed in 1999. They are working closely with the Battle Creek Working Group that includes the Battle Creek Watershed Conservancy, other CALFED agencies and other interested parties.

A third example of restoration in the Sacramento River region lies on Clear Creek, which is also a tributary to the Sacramento River, near Redding, in Shasta County. Restoring Clear Creek is identified in several significant documents and/or act of legislation, including CVPIA, Section 3406, (b)(12). Through increasing flow in the creek by releasing more water from Whiskeytown Dam; the removal of McCormick-Saeltzer Dam in the year 2000; supplementing the gravel supply which was blocked by Whiskeytown Dam; implementing methods to control erosion having negative impacts to salmonid habitat; and restoring the stream channel the Clear Creek Restoration Program has contributed significantly to the five-fold increase in fall Chinook spawning escapements in Clear Creek from 1995 to 2002 over the baseline period of 1967 to 1991. Data also show trends of increases in steelhead and Spring-run Chinook spawning and juvenile production.

In addition to the projects discussed above, another program under the ERP which is active in the region is the Environmental Water Program (EWP). The goal of this program is to identify and purchase 100,000

acre feet of water annually to augment in-stream flows. Four of the five Tier 1 priority streams for the program lie within the Region: Clear Creek, Mill Creek, Butte Creek and Deer Creek. The EWP is also working closely with Battle Creek, which has been identified as a Tier 2 priority stream in this program. Development of a regional implementation structure for the Ecosystem Restoration Program Plan that is consistent with and in collaboration with existing local restoration program integration efforts is vital. Development of a regional implementation structure for the Ecosystem Restoration Program Plan that is consistent with and in collaboration with existing local restoration program integration efforts is vital. There are currently numerous watershed groups within the region compiling valuable data and involved in restoration projects within their watersheds. However, these are only a piece of the larger fabric of the greater Sacramento River watershed. Efforts are continuing to provide a comprehensive view of the watershed based on information gathered from funded projects throughout the watershed. This will allow for more informed decision-making and better protection and use of the resources.

To summarize, the Ecosystem Restoration Program (ERP) and CALFED Watershed program has provided the following through Year 3 of the California Bay Delta Program:

- $172 million invested in 139 local ecosystem restoration projects. Funded projects, including over 50 projects to improve fish passage, restore habitat, monitor and assess watersheds, and provide education and outreach.
- $11.4 million invested in 40 local watershed projects addressing areas such as spawning gravel, floodplain management and watershed education and outreach.
- $12 million provided for studies addressing mercury and other pollutants associated with abandoned mines.

Looking to the Future

Water agencies in the region continue to be proactive in managing water supplies in light of changing conditions within the region and the state. An example is the Sacramento Valley Water Management Program (SVWMP). This resource management program was established as an alternative to SWRCB Phase 8 litigation proceedings designed to determine the responsibility of meeting water quality standards in the Delta. This unprecedented agreement establishes a process by which the parties are collaborating in the development and implementation of a variety of water management projects that will increase the availability of Sacramento Valley water resources. The agreement provides that increased supplies will be used first to fully meet the in basin needs, but would also be made available to help meet the requirements of the 1995 Water Quality Control Plan, provide other environmental benefits, and potentially meet additional export needs.

The key to this program is to keep it focused on integrated regional planning. Currently, the SVWMP work team of leading hydrologists and engineers is involved in integrating more than fifty projects into both short and long-term work plans with regional scopes and benefits. These projects are designed to protect Northern California surface water rights and groundwater basins through the implementation of groundwater planning and monitoring that provides for unmet demands within the Sacramento Valley prior to export of water to other regions. They include system improvement and water-use efficiency measures, conjunctive management and surface water re-operation projects that include groundwater protection elements. The SVWMP is based on the tenant that all projects must be managed and controlled by the local interests within the Sacramento Valley. This program is currently undergoing a programmatic

environmental review and will seek public funds, including Proposition 50, to help implement many of these projects.

In addition to the Sacramento Valley Water Management Program, several other entities are working to improve water supply reliability and quality within the region and throughout the state. For example, the Redding Area Water Council is considering local water transfers, conjunctive use of groundwater, groundwater management, and additional surface water developments to increase supplies.

The Regional Water Authority is a joint powers authority that serves and represents the interests of nearly 20 water providers in the greater Sacramento Area. The organization's primary mission is to help its members protect and enhance the reliability, availability, affordability and quality of water resources within this area of the region.

The American River Water Forum has two, co-equal objectives: 1) Provide a reliable and safe water supply for the region's economic health and planned development through the year 2030; and 2) Preserve the fishery, wildlife, recreational and aesthetic values of the lower American River.

The Sacramento Valley Water Quality Coalition (SVWQC) was formed in response to the recent decision by the Regional Water Quality Control Board to revise discharge waivers for agricultural users. This group comprised of County Agricultural Commissioners, Ducks Unlimited, Inc., independent Farm Bureaus from throughout the region, independent landowners and the Northern California Water Association is working with members of the agricultural community to develop a monitoring and reporting program in response to the loss of the discharge waiver. This group is currently identifying participants, collecting contact information and attempting to specify the location of all discharges within the region.

Regional Planning and Coordination

Regional coordination provided by the CBDA in the Sacramento River Region is just beginning and will be focused on fostering regional cooperation and helping regional interests develop programs that are mutually beneficial to the various stakeholders. Efforts will be made to assist the stakeholders within the region by increasing communication within the region and between the region and CBDA Programs.

CBDA staff and state federal and local agencies will work closely with Sacramento Valley stakeholders, including those identified above as well as local elected officials, water district elected officials and staff, public agencies, watershed groups, environmental activists and other interested members of the public. The goal will be to assist the region in the creation of a regional planning strategy. This strategy will allow local stakeholders to have a voice in activities supported by CBDA through funding within the region. It will also outline how the region will coordinate these activities with other regions throughout the Bay-Delta solution area.

In addition to the regional approach being taken along the Sacramento River through the SRCAF, other regional endeavors should be encouraged. For instance, in the northern Sacramento Valley, contiguous aquifer systems underlie several counties. As a result, utilization of the groundwater resource by one county may impact another. Therefore, regional coordination and cooperation is essential for the individual users as well as the benefit of the region as a whole.

Outreach efforts are contemplated to educate local elected officials and landowners about implementation of the CBDA plan in the Sacramento Valley and provide briefings and announcements on regional activities. The coordination of these activities with local governments and local conservation organizations will help inform the local leaders and build trust within the region.

Although many Northern California counties lack the resources and funding to assist them with regional or local plans, several have sought and obtained grant funding and formed working partnerships to help them in this capacity. Both Butte and Tehama County have completed an Inventory/Analysis of their water resources to assist them in future water planning activities. Lake County has recently applied for funding under AB 303 to do the same. Butte County has moved forward with the development of an integrated plan and similar programs regarding groundwater management are being pursued in Glenn, Plumas, Sutter, Shasta, Tehama and Sacramento Counties. Glenn, Tehama and Butte Counties have obtained funding to increase their groundwater monitoring activities through AB 303 grant funding. Several other entities, such as Anderson-Cottonwood Irrigation District, Deer Creek Irrigation District, Glenn-Colusa Irrigation District, Western Canal Water District and Maxwell Irrigation District have all augmented their groundwater monitoring activities within the region as well. A number of other counties and non-profit groups and Resource Conservation Districts (RCDs) within the region have received funding for major ecosystem restoration and conservation programs through the CBDA program.

Water Portfolios for Water Years 1998, 2000 and 2001

The following tables present actual information about the water supplies and uses for the Sacramento River hydrologic region. Water year 1998 was a wet year for this region, with annual precipitation at 165 percent of normal, while the statewide annual precipitation was 170 percent of average. Year 2000 represents nearly normal hydrologic conditions with annual precipitation at 110 percent of average for the Sacramento River region, and year 2001 reflected dryer water year conditions with annual precipitation at 70 percent of average. For comparison, statewide average precipitation in year 2001 was 75 percent of normal. Table 6-1 provides more detailed information about the total water supplies available to this region for these three specific years from precipitation, imports and groundwater, and also summarizes the uses of all of the water supplies. The three Water portfolio tables included in Table 6-2 and companion Water Portfolio flow diagrams Figures 6-2, 6-3 and 6-4 provided more detailed information about how the available water supplies are distributed and used throughout this region.

A more detailed tabulation of the portion of the total available water that is dedicated to urban, agricultural and environmental purposes is presented in Table 6-3. Because much of the Sacramento River region is devoted to agricultural activities, a large component of the developed water is supplied to agricultural purposes. Dedicated environmental water use is also a large component of the developed water supply, primarily because the required Sacramento – San Joaquin Delta outflow is accounted for within this region. Table 6-3 also provides detailed information about the sources of the developed water supplies, which are primarily from surface water systems of the Sacramento River and its tributaries. The use of available groundwater supplies is also a significant resource to this region.

Sources of Information

- Water Quality Control Plan, Regional Water Quality Control Board
- Watershed Management Initiative Chapter, Regional Water Quality Control Board
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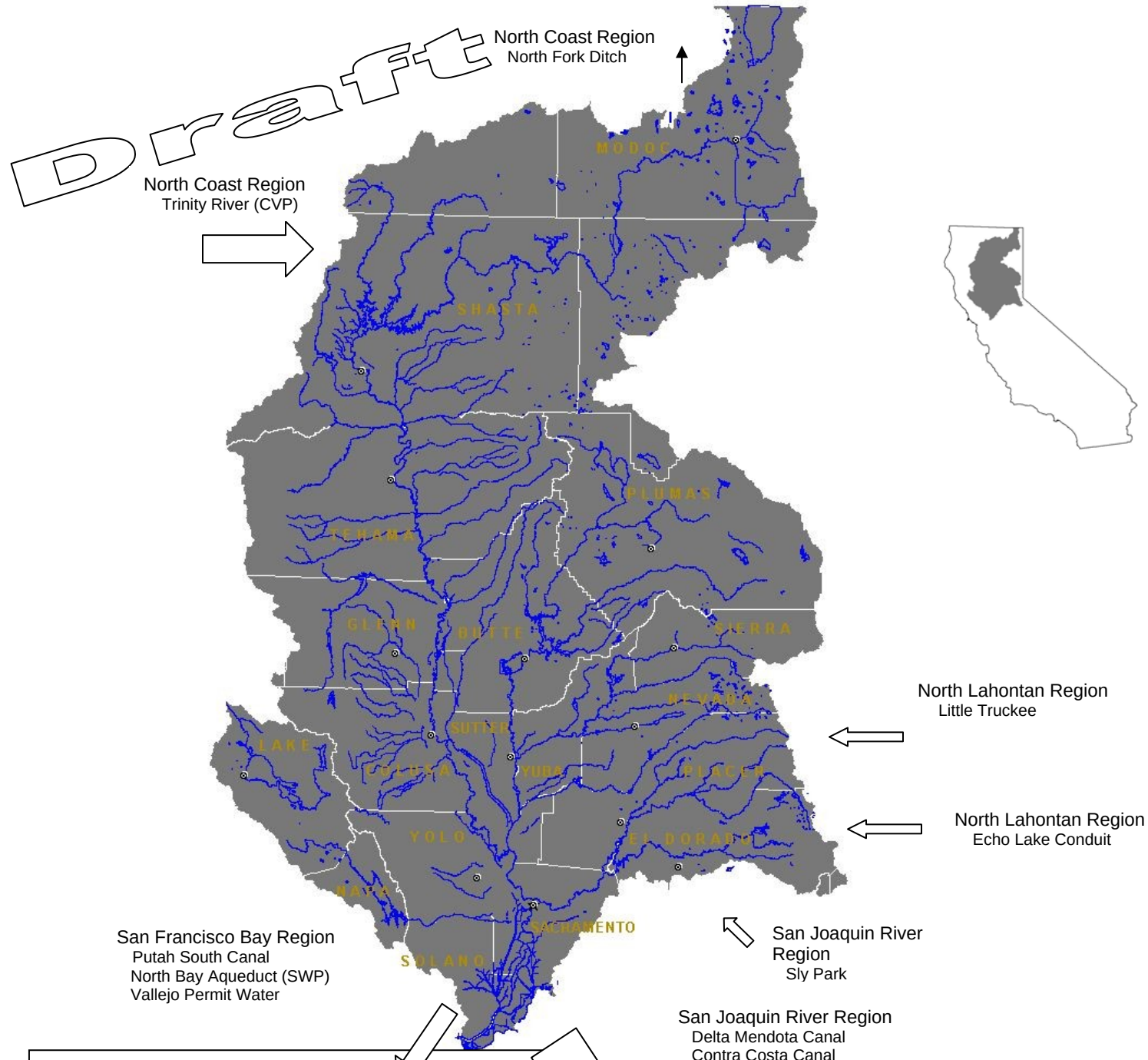
- Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, State Water Resources Control Board, California Coastal Commission, January 2000
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001
- Hanak, Ellen 2003, Who Should be Allowed to Sell Water in California? Third-Party Issues and the Water Market, Public Policy Institute of California
- Smith, F. 1980. A short review of the status of riparian forests in California. Pages 1-2 in: A. Sands (Editor). Riparian Forests in California. University of California Press, Berkeley, CA.
- Kelley, Robert 1998 Battling the Inland Sea, University of California Press, Berkeley
- U.S.D.A. Forest Service Web site at www.fs.fed.us/recreation/map/state_list.shtml#California
- California Department of Fish and Game (CDFG). 2001. Spring-run Chinook salmon annual report for the Fish and Game Commission.

Figure 6-1
Sacramento River Hydrologic Region



Some Statistics

- Area - 27,246 square miles (17.2 % of State)
- Average annual precipitation – 36.7 inches
- Year 2000 population - 2,593,115
- 2030 projected population –
- Total reservoir storage capacity - 16,146 TAF
- 2000 irrigated agriculture - 2,019,700 acres

Table 6-1
Sacramento River Hydrologic Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	1998 (wet)	2000 (average)	2001 (dry)
Water Entering the Region			
Precipitation	89,500	57,106	35,895
Inflow from Oregon/Mexico	0	0	0
Inflow from Colorado River	0	0	0
Imports from Other Regions	669	669	669
Total	**90,169**	**57,775**	**36,564**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	4,136	5,549	5,460
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	2,266	5,114	3,761
Statutory Required Outflow to Salt Sink	15,372	12,301	8,796
Additional Outflow to Salt Sink	35,119	12,309	3,947
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	29,784	23,754	18,159
Total	**86,677**	**59,027**	**40,123**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	2,752	-1,101	-2,412
Change in Groundwater Storage **	740	-151	-1,147
Total	**3,492**	**-1,252**	**-3,559**

Applied Water * (compare with Consumptive Use)	6,962	9,202	9,094

* Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

GW change in storage =

intentional recharge + deep percolation of applied water + conveyance deep percolation - withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

Table 6-2
Water Portfolios for Water Years 1998, 2000 and 2001

Category	Description	Sacramento River 1998 (TAF)				Sacramento River 2000 (TAF)				Sacramento River 2001 (TAF)				Data
Inputs:		Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	**Detail**
1	Colorado River Deliveries		-				-				-			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		-				-				-			PSA/DAU
5	Precipitation	89,500.1				57,105.9				35,894.8				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	N/A				N/A				N/A				REGION
9	Local Deliveries		14,297.8				12,189.0				8,823.5			PSA/DAU
10	Local Imports		9.7				10.9				8.5			PSA/DAU
11a	Central Valley Project :: Base Deliveries		1,588.8				1,930.8				2,021.3			PSA/DAU
b	Central Valley Project :: Project Deliveries		418.6				554.2				495.7			PSA/DAU
12	Other Federal Deliveries		198.0				228.3				239.5			PSA/DAU
13	State Water Project Deliveries		14.9				14.9				19.6			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow		3,699.6				3,759.8				3,747.5			REGION
16	Environmental Water Account Releases						264.0				242.0			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		60.1				44.7				45.3			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetlands		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		206.0				270.0				268.2			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		23.8				24.5				13.4			PSA/DAU
19a	Recycled Water - Agriculture		-				-				-			PSA/DAU
b	Recycled Water - Urban		-				-				-			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		985.4				1,215.1				957.6			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		4.0				4.2				4.4			PSA/DAU
c	Return Flow to Developed Supply - Urban		11.9				11.8				13.3			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		179.1				299.8				320.3			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		8.3				11.6				12.3			PSA/DAU
c	Deep Percolation of Applied Water - Urban		79.8				88.7				90.8			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		367.7				569.1				446.2			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		1,001.4				1,019.9				619.3			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				219.7			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		5,897.3				4,835.4				4,098.4			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	9,727.2				11,603.3				10,502.6				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	-				-				-				PSA/DAU
29	Groundwater Extractions - Unadjudicated	1,855.9				2,803.1				2,922.7				REGION
Withdrawals:	**In Thousand Acre-feet**													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	12,479.2				10,502.6				8,090.8				PSA/DAU
31	Groundwater Recharge-Contract Banking		-				-				-			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				320.7				331.5				326.1	REGION
b	Evaporation from Reservoirs				700.7				798.5				728.9	REGION
36	Ag Effective Precipitation on Irrigated Lands		1,358.0				1,058.3				1,056.4			REGION
37	Agricultural Use		5,845.1	5,298.3	4,312.9		7,930.8	7,061.9	5,846.9		7,781.6	7,015.1	5,832.7	PSA/DAU
38	Wetlands Use		398.3	345.5	311.3		429.5	377.3	342.9		445.5	378.4	343.8	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		115.2				127.4				132.9			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		231.0				267.7				280.0			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		72.3				88.0				90.4			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		18.1				22.2				22.7			PSA/DAU
40	Urban Commercial Use		112.7				140.3				136.4			PSA/DAU
41	Urban Industrial Use		77.4				84.4				84.4			PSA/DAU
42	Urban Large Landscape		91.5				111.6				119.7			PSA/DAU
43	Urban Energy Production		-				0.3				0.1			PSA/DAU
44	Instream Flow		3,699.6	3,699.6	3,699.6		3,759.8	3,759.8	3,759.8		3,747.5	3,747.5	3,747.5	PSA/DAU
45	Required Delta Outflow		9,505.0	9,505.0	9,505.0		7,231.6	7,231.6	7,231.6		4,486.2	4,486.2	4,486.2	PSA/DAU
46	Wild & Scenic Rivers Use		3,124.4	2,167.5	2,167.5		2,024.7	1,045.4	1,045.4		885.0	320.5	320.5	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				3,693.1				5,008.5				4,913.7	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				127.5				169.7				162.9	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				315.2				371.1				383.6	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				0.2				0.1				0.2	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				122.2				173.4				173.9	PSA/DAU
50	Urban Waste Water Produced	252.2				301.0				311.6				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				4.9				4.3				4.3	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				40.6				61.5				59.9	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				11.7				16.3				15.5	PSA/DAU
d	Conveyance Loss to Mexico				-				-				-	PSA/DAU
52a	Return Flows to Salt Sink - Ag				643.9				848.7				939.6	PSA/DAU
b	Return Flows to Salt Sink - Urban				313.5				371.7				380.2	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				179.2				164.0				169.4	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				33,981.9				10,924.2				2,457.9	REGION
54a	Outflow to Nevada													REGION
b	Outflow to Oregon				-				-				-	REGION
c	Outflow to Mexico													REGION
55	Regional Imports	668.5				668.5				668.5				REGION
56	Regional Exports	2,266.2				5,114.3				3,761.4				REGION
59	Groundwater Net Change in Storage	739.9				-150.8				-1,146.6				REGION
60	Surface Water Net Change in Storage	2,752.0				-1,100.7				-2,411.8				REGION
61	Surface Water Total Available Storage	16,145.6				16,145.6				16,145.6				REGION

Colored spaces are where data belongs. N/A - Data Not Available "-" - Data Not Applicable "0" - Null value

Table 6-3
Sacramento River Hydrologic Region Water Use and Distribution of Dedicated Supplied

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	91.5			111.6			119.7		
Commercial	112.7			140.3			136.4		
Industrial	77.4			84.4			84.4		
Energy Production	0.0			0.3			0.1		
Residential - Interior	187.5			215.4			223.3		
Residential - Exterior	249.1			289.9			302.7		
Evapotranspiration of Applied Water		315.2	315.2		371.1	371.1		383.6	383.6
Irrecoverable Losses		0.2	0.2		0.1	0.1		0.2	0.2
Outflow		311.1	308.5		370.1	367.5		378.6	376.0
Conveyance Losses - Applied Water	9.9			8.5			8.5		
Conveyance Losses - Evaporation		4.9	4.9		4.3	4.3		4.3	4.3
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		5.0	5.0		4.2	4.2		4.2	4.2
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Urban Use	**728.1**	**636.4**	**633.8**	**850.4**	**749.8**	**747.2**	**875.1**	**770.9**	**768.3**
Agriculture									
On-Farm Applied Water	5,845.1			7,930.8			7,781.6		
Evapotranspiration of Applied Water		3,693.1	3,693.1		5,088.5	5,088.5		4,913.7	4,913.7
Irrecoverable Losses		122.2	122.2		173.4	173.4		173.9	173.9
Outflow		1,483.0	497.6		1,880.1	665.0		1,922.4	964.8
Conveyance Losses - Applied Water	615.9			779.9			780.4		
Conveyance Losses - Evaporation		40.6	40.6		61.5	61.5		59.9	59.9
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		206.4	146.3		228.4	183.7		239.8	194.5
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**6,461.0**	**5,545.3**	**4,499.8**	**8,710.7**	**7,351.9**	**6,092.1**	**8,562.0**	**7,309.7**	**6,306.8**
Environmental									
Instream									
Applied Water	3,699.6			3,759.8			3,747.5		
Outflow		3,699.6	3,699.6		3,759.8	3,759.8		3,747.5	3,747.5
Wild & Scenic									
Applied Water	3,124.4			2,024.7			885.0		
Outflow		2,167.5	2,167.5		1,045.4	1,045.4		320.5	320.5
Required Delta Outflow									
Applied Water	9,505.0			7,231.6			4,486.2		
Outflow		9,505.0	9,505.0		7,231.6	7,231.6		4,486.2	4,486.2
Managed Wetlands									
Habitat Applied Water	398.3			429.5			445.5		
Evapotranspiration of Applied Water		127.5	127.5		169.7	169.7		162.9	162.9
Irrecoverable Losses		9.8	9.8		14.4	14.4		14.2	14.2
Outflow		208.2	204.2		193.2	189.0		201.5	197.1
Conveyance Losses - Applied Water	40.8			42.0			23.3		
Conveyance Losses - Evaporation		1.9	1.9		1.9	1.9		1.3	1.3
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		5.2	5.2		5.2	5.2		2.7	2.7
Total Managed Wetlands Use	439.1	352.6	348.6	471.5	384.4	380.2	468.8	382.6	378.2
Total Environmental Use	**16,768.1**	**15,724.7**	**15,720.7**	**13,487.6**	**12,421.2**	**12,417.0**	**9,587.5**	**8,936.8**	**8,932.4**
TOTAL USE AND LOSSES	**23,957.2**	**21,906.5**	**20,854.3**	**23,048.7**	**20,522.9**	**19,256.3**	**19,024.6**	**17,017.4**	**16,007.5**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	14,297.8	14,297.8	13,387.6	12,189.0	12,189.0	11,154.8	8,823.5	8,823.5	8,055.9
Local Imported Deliveries	9.7	9.7	9.1	10.9	10.9	10.0	8.5	8.5	7.8
Colorado River Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CVP Base and Project Deliveries	2,007.4	2,007.4	1,879.6	2,485.0	2,485.0	2,274.2	2,517.0	2,517.0	2,298.0
Other Federal Deliveries	198.0	198.0	185.4	228.3	228.3	208.9	239.5	239.5	218.7
SWP Deliveries	14.9	14.9	14.0	14.9	14.9	13.6	19.6	19.6	17.9
Required Environmental Instream Flow	3,962.8	3,962.8	3,962.8	3,422.2	3,422.2	3,422.2	3,133.4	3,133.4	3,133.4
Groundwater									
Net Withdrawal	1,415.9	1,415.9	1,415.9	2,172.6	2,172.6	2,172.6	2,275.9	2,275.9	2,275.9
Artificial Recharge	0.0			0.0			5.0		
Deep Percolation	440.0			630.5			641.8		
Reuse/Recycle									
Reuse Surface Water	1,610.7			1,895.3			1,360.4		
Recycled Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL SUPPLIES	**23,957.2**	**21,906.5**	**20,854.4**	**23,048.7**	**20,522.9**	**19,256.3**	**19,024.6**	**17,017.4**	**16,007.5**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 6-2
Sacramento River Hydrologic Region 1998 Flow Diagram

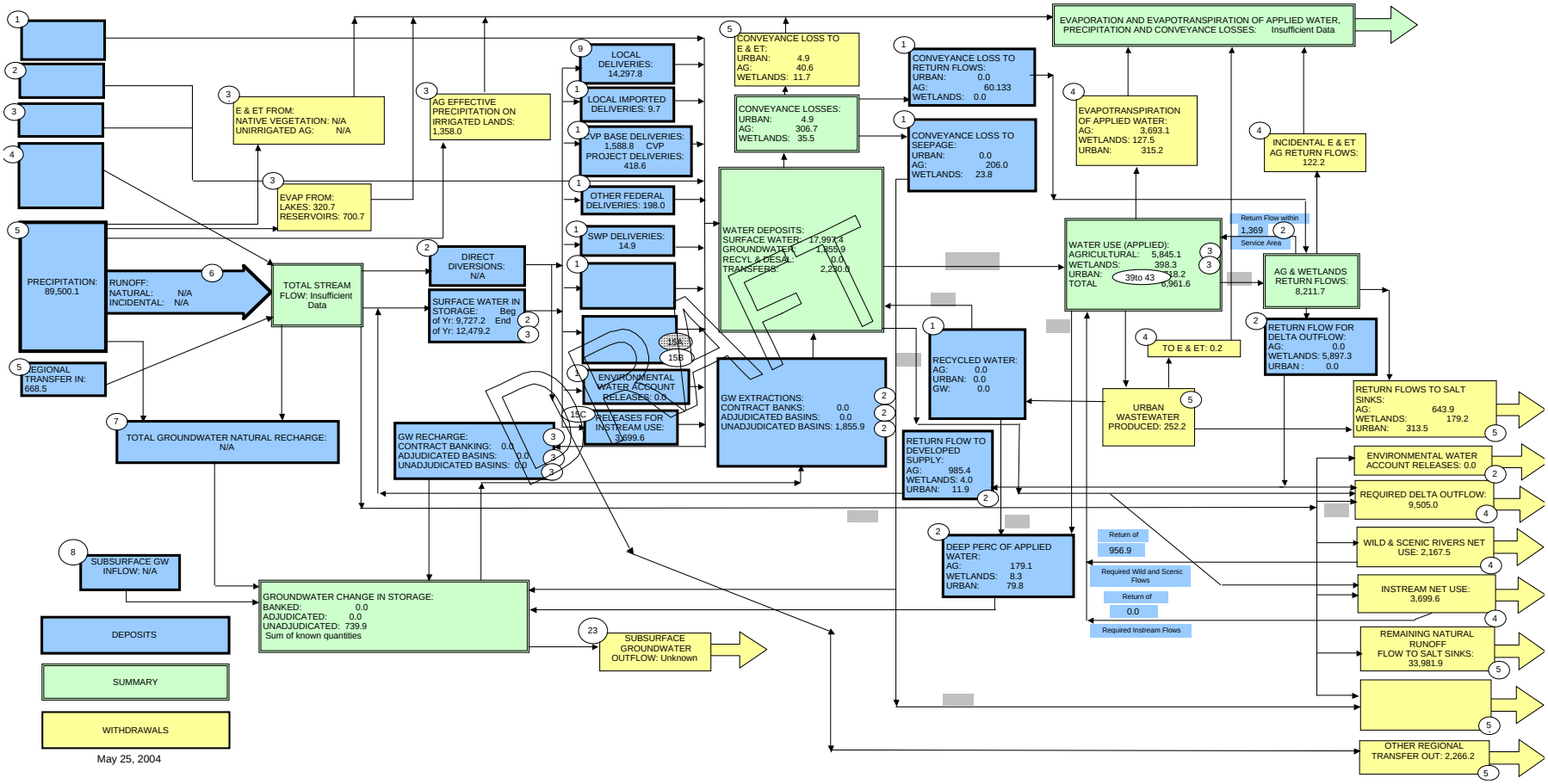


Figure 6-3
Sacramento River Hydrologic Region 2000 Flow Diagram

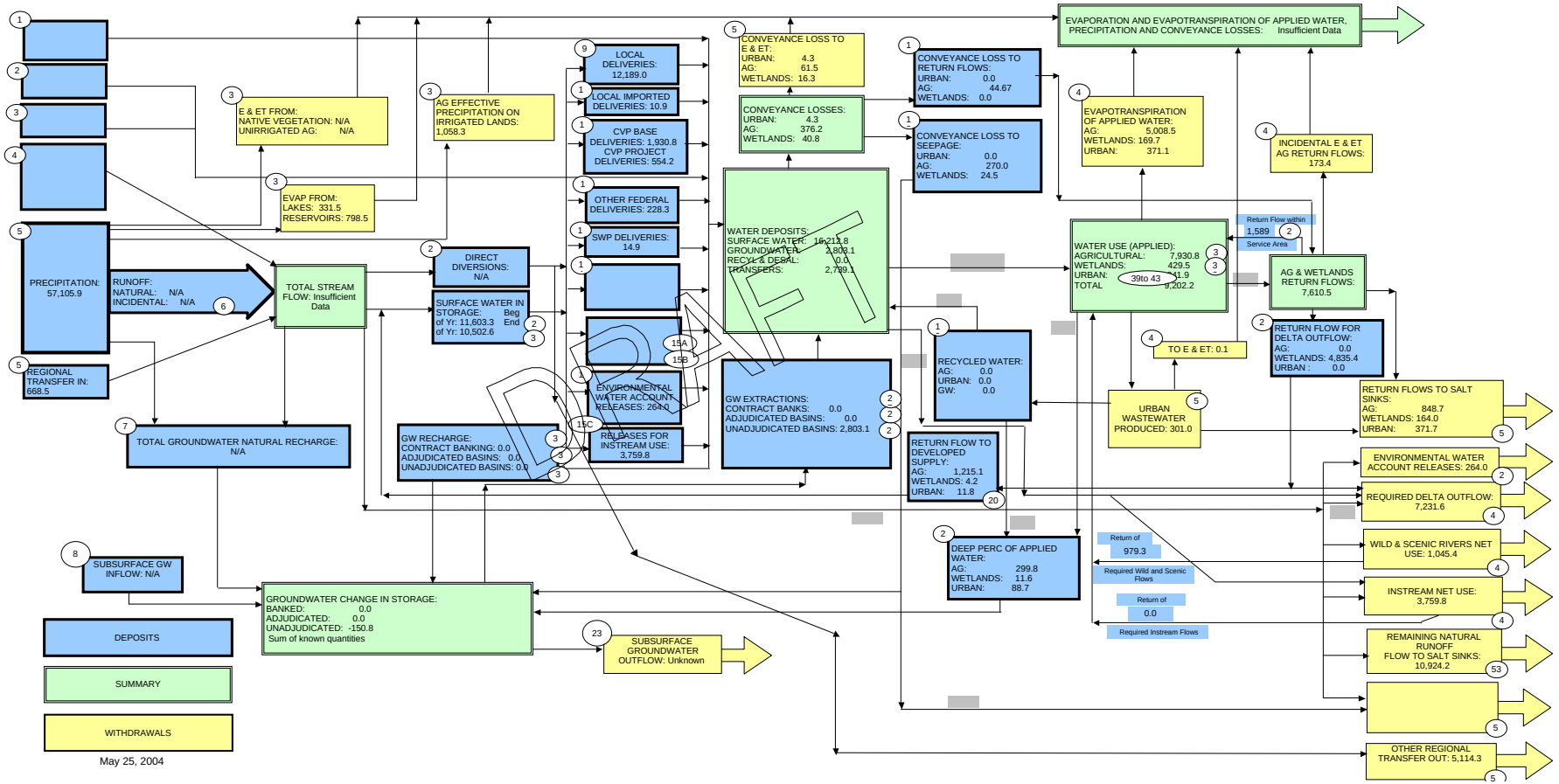


Figure 6-4
Sacramento River Hydrologic Region 2001 Flow Diagram